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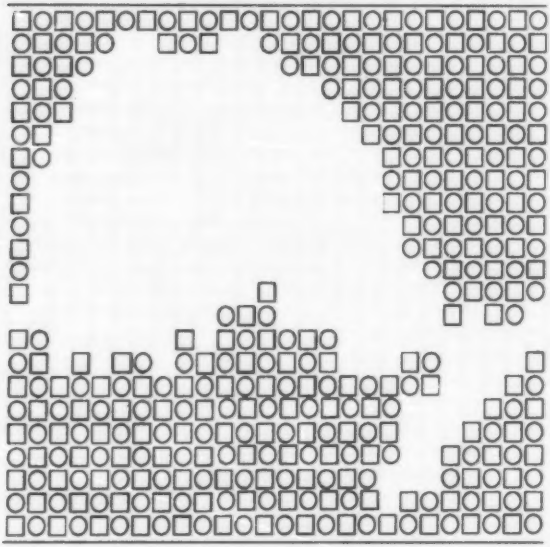
Designated Substances in the Workplace: A Guide to the Silica Regulation



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Designated Substances in the Workplace: A Guide to the Silica Regulation

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Introduction

The guide has been prepared to help employers, workers, members of joint health and safety committees, supervisors and occupational health personnel meet the requirements of the designated substance regulation respecting silica in the workplace and to understand the responsibilities this regulation places on all participants in the workplace health and safety system.

The advice in this guide is an interpretation, by officials of the Operations Division, of the *Occupational Health and Safety Act* (the Act) and regulations.

The advice does not have binding effect but is intended to provide general answers to possible questions asked in the context of a specific situation. It is being used by staff of the ministry to assist in the administration of the silica regulation.

Questions of construction and application will find their ultimate answer given by the courts where a contest ensues as to the construction or application of a legislative provision.

The Operations Division of the Ministry of Labour is responsible for administering the Act. One of the oldest recognized occupational hazards, silica became the seventh designated substance to be regulated under the Act. The Regulation respecting Silica, Ontario Regulation 769/83 was filed with the Registrar of Regulations on December 9, 1983. The provisions relating to the assessment came into force on the date of filing; those relating to control measures came into force on March 8, 1984. The regulation was subsequently amended, most recently in June, 2000,

and is now known as Regulation 845, as amended by O. Reg. 521/92 and O. Reg. 391/00.

This guide is intended as a supplement to the booklet entitled *Designated Substances in the Workplace: A General Guide to the Regulations* to help employers meet the requirements of the silica regulation. It reviews the health effects of silica, its uses and the forms of workplace exposure. In addition, it provides information on the application of the regulation, allowable exposure levels, the assessment and control program, and medical surveillance.

It is important that both this guide and the general guide to the regulations referred to above be consulted.

For further information on any aspect of the silica regulation, you should contact the appropriate Ministry of Labour field office. Appendix 3 lists the addresses and telephone numbers of the ministry field offices. Appendix 4 gives a list of further reading materials that may be helpful in understanding the background to the requirements of the regulation.

1. The Hazards of Silica in the Workplace

What Is Silica and How Is It Used?

Silica (SiO_2) is a compound resulting from the combination of one atom of silicon with two atoms of oxygen. It can occur naturally as a crystalline (periodic, random distribution of atoms) or amorphous (non-periodic, random distribution of atoms) material. Crystalline silica is significantly more toxic than amorphous silica; therefore, for health reasons, only the crystalline varieties are regulated. There are several forms of crystalline silica, of which three may be encountered in the workplace: quartz, cristobalite and tridymite. Of these, quartz is the most abundant and constitutes over 30 per cent of the Earth's crust.

Silica can also combine with metals to form silicates, such as feldspars and the different forms of asbestos. The health effects of silica and silicates differ significantly, and to distinguish silica from the silicates, it is commonly referred to as free crystalline silica, meaning it is that form of silica that is crystalline and not chemically combined with any metals.

In nature silica or quartz may occur as a pure substance (e.g., beach sand, moulding sands) or in physical combination with clays, feldspars and other silicates. Tripoli is a rock that is composed principally of microcrystalline quartz.

Table 1 shows the range in content of free crystalline silica in various bulk materials that may be encountered in industry.

TABLE 1

Free Crystalline Silica Content of Various Materials

Material	Crystalline Silica (%)
Tripoli	+ 95
Foundry Moulding Sand	up to 90
Road Rock	up to 80
Buffing Wheel Dressings	up to 60
Clay	up to 40
Ontario Gold Mines (in the rock)	up to 35
Brick and Tile Compositions	10-35
Pottery Ware	15-25
Naturally containing products such as feldspar, mica, talc and limestone	up to 25

The qualities of hardness and resistance to mechanical and chemical alterations make silica a valuable substance in several industrial processes.

Silica is used in sandblasting; manufacture of abrasive, grinding and scouring compounds; moulds for castings; fillers for paints and mastic; manufacture of glass, optical equipment, pottery, ceramics, electronic components, fibreglass, and radio and TV components.

Silica flour (a finely powdered form of silica) is used in the manufacture of abrasive cleaning powders and cement blocks. However, no distinction is made between silica flour and other fine particles of silica in the silica regulation.

Why Is Silica a Health Hazard?

The prolonged inhalations of dust containing free crystalline silica results in a disease known as silicosis. Silicosis is a pneumoconiosis (a lung disease caused by the inhalation of dust) characterized by progressive fibrosis of the lungs and marked by shortness of breath and impaired lung function and may give rise to complications sometimes resulting in death. These harmful effects can be prevented by adherence to a comprehensive silica control program.

Crystalline silica may be harmful following a high dose received over a relatively short period of time (acute silicosis) ranging from a few weeks to four or five years or after long-term exposure to lower doses (chronic silicosis).

Acute silicosis is a lung disease that develops rapidly. As few as eight to 18 months may elapse from the time of first exposure to the onset of symptoms, which include progressive shortness of breath, fever, cough and weight loss. There is a rapid progression of respiratory failure usually resulting in death within one or two years. Acute silicosis has been found to occur among workers in the following occupations: sandblasting, sand pulverizing, rock drilling in quarries and the manufacture of abrasive soaps.

Chronic silicosis is similar to acute silicosis but has a much longer latency period, usually more than 10 years, before symptoms occur and may progress and worsen over a period of many years. Chronic silicosis may be either a simple or a complicated type. Simple silicosis is almost entirely without symptoms. The earlier signs may include cough, sputum and breathlessness. In the early stages of the disease the lung nodules are small (usually 1 to 3 mm) and discrete in the upper lung fields. As the disease progresses the nodules increase in number and size and also occupy the lower lung field.

Complicated silicosis is accompanied by increased breathlessness, a persistent cough and a restrictive ventilatory defect as well as impairment of gas transfer in the lung. As well as cardiac and respiratory failure, silicosis also increases the risk of tuberculosis and other recurrent chest infections.

What Form of Silica Can Be Dangerous to Workers?

Free silica occurs naturally in two forms: crystalline and amorphous. Inhalation of free silica dust that is crystalline can affect the health of workers. Quartz, cristobalite and tridymite are the three most common types of free crystalline silica that may be inhaled and result in silicosis.

Respirable quartz is the portion of airborne free crystalline silica with particles sufficiently small to be inhaled deeply into the lungs and reach the alveoli; most of the dust particles have an aerodynamic diameter less than 5.0 micrometers (μm).

Silica dust may be generated through processes such as:

- drilling
- blasting
- grinding
- crushing
- sandblasting

- transporting of silica or silica-containing material
- pouring of silica or silica-containing material
- sand moulding in foundries.

How Does Silica Enter the Body?

Most occupational exposure to silica occurs through breathing in the dust. Among particles that are inhaled, those with an aerodynamic diameter larger than about 10 micrometers (μm) are essentially all removed in the nasal passages and upper airways. About 50 per cent of particles of 5 μm in diameter penetrate further than the nose during normal breathing. Particles of 5.0 μm to 0.5 μm in diameter are carried into the smaller airways and alveoli and are deposited there. Extremely small particles less than 0.5 μm in diameter are mostly exhaled.

The small particles of silica dust that are not expelled from the lung remain in the lung and are deposited in lymph nodes. The reaction of the body to these particles often shows on the chest X-ray. After a time, calcium can deposit in those nodes and settle along the rim of the lymph node. This condition is known as "egg-shell" calcification. Silica particles are carried into the lungs of some people. The lung forms a scar around the particles and the hardened scars gradually start to show up on the chest X-ray as fibrosis of the lung.

The proportion of dust particles that are respirable (small enough to penetrate to the alveoli) varies. Typically, in industrial dust clouds, as little as five per cent to more than 50 per cent by weight of the dust may be respirable.

2. The Silica Regulation

Who Is Covered by the Silica Regulation?

With the exception of construction projects (explained below), the regulation applies to every employer and worker at a workplace where crystalline silica in the respirable form is present and at which a worker is likely to inhale silica.

Does the Regulation Apply to Construction Projects?

If the construction project is located at a workplace to which the regulation applies, then the employer responsible for the workplace is required to comply with sections 4 and 5 of the regulation with respect to the workers on the project. (Sections 4 and 5 set allowable exposure levels for airborne silica and determine the conditions under which respirators may be used as a means of complying with these requirements.)

Other construction projects are not covered by the regulation.

What Are the Allowable Airborne Concentrations of Silica?

The exposure of a worker to silica must not exceed the levels specified in the regulation:

Time-Weighted Average (TWA) Exposure Concentration

The employer is obligated to reduce the TWA to the lowest practical level and ensure that it does not exceed 0.1 mg of silica per m^3 of air, in the case of quartz or tripoli, or 0.05 mg of silica per m^3 of air, in the case of cristobalite or tridymite.

The time-weighted average exposure of a worker is calculated on the basis of cumulative weekly exposure (40 hours), and cumulative daily exposure (8 hours), as indicated in the Schedule appended to the regulation.

The exposure value is to be achieved by the employer through the use of engineering controls, work practices, and hygiene practices and facilities. Only in emergencies or in cases where there are no practical or technically feasible alternatives are these allowable exposures to be achieved through the use of respirators worn by workers.

Chapter 1 of *A General Guide to the Regulations* discusses the lowest practical level of exposure and reads:

> "The lowest practical level will depend on the characteristics of the individual work site. The employer is required to adopt those engineering controls, work practices and hygiene practices that a responsible and prudent employer would put into effect, taking into consideration the plant, equipment, engineering controls and work practices in the workplace, and what can realistically and reasonably be done by way of improvement, modification and replacement.
>
> There are a number of factors that should be considered in determining whether the lowest practical level has been obtained. Some of these factors are:
>
> 1) The extent of the health benefits that will likely be obtained from improvements or modifications to existing engineering controls, etc., in the workplace.
>
> 2) The exposure levels that were achieved in the work site in the past.
>
> 3) The exposure levels being met in similar work sites.

4) The cost of introducing new engineering controls, or modifying those already in place.

5) The technological feasibility of achieving lower exposure levels."

It must be emphasized that the lowest practical level refers to the time-weighted average exposure only. It is likely that short-term fluctuations in exposure above this level will occur.

3. Assessing and Controlling Exposure to Silica

The Assessment

Chapter 2 of *A General Guide to the Regulations* describes how to assess the extent to which workers are exposed to silica. When carrying out this assessment you must note all processes involving silica and all potential sources of airborne silica.

Table 2 presents a list of industrial processes or operations that have varying potentials for worker exposure to silica. Any work or operation of this nature should be carefully assessed for possible exposure to silica. Wherever silica dust may be generated, pay particular attention to housekeeping, work practices, and hygiene practices and facilities.

A written assessment report must be prepared and should include a summary of the information gathered and the analysis of these data. The report must state whether there is actual or potential exposure of workers to silica and whether their health may be affected. The conclusion must indicate whether or not a control program is necessary. More information on the conclusions that may be reached is outlined in Chapter 2 of *A General Guide to the Regulations*.

It may be necessary to include air sampling as part of the assessment for silica. Chapter 6 of *A General Guide to the Regulations* explains in detail the procedures for air monitoring that should be used to determine the concentration of silica in workplace air.

TABLE 2

Work Operations and Workplaces with Potential Silica Exposure

- sandblasting
- manufacture of abrasives
- manufacture of grinding and scouring compounds
- manufacture of moulds for castings
- manufacture of fillers for paints and mastic
- manufacture of glass
- manufacture of optical equipment
- manufacture of pottery
- manufacture of ceramics
- manufacture of electronic components
- manufacture of fibreglass
- manufacture of radio and TV components
- brick and cement work
- buffing, metal polishing and grinding
- foundries (ferrous and non-ferrous)
- cutting granite
- quarries
- steel plants
- stone and clay makers

The Control Program

Engineering Controls

If a silica control program is required, it must include engineering controls to reduce the exposure of workers to silica. These controls can be grouped into the categories outlined in Chapter 4 of *A General Guide to the Regulations*. Examples of appropriate controls for some types of silica operations are indicated on the **process flow sheets** included in Appendix 1 of this guide and are discussed below.

Product Substitution

It may be possible to eliminate silica from certain processes in the workplace by replacing it with a less toxic material. For example:

- Silica sand used in abrasive blasting may be replaced by metal shot and grit, alumina, garnet, nutshells, cereal husks, sawdust, high pressure water, steel sand, silicon carbide or corundum.
- Sandstone grinding wheels may be replaced by artificial abrasive wheels (usually of aluminium oxide).
- Metal moulds may be substituted for sand moulds in foundry casting operations.
- Silica parting compounds used in foundries may be replaced by calcium carbonate.
- Olivine sand may be used to replace quartz sand in foundries. Additionally, dust levels may be reduced by adding oil instead of soot to moulding sand.
- Magnesite or aluminum oxide bricks may replace silica bricks in furnaces, vaults and ladles in steelworks.

Process Changes

In some situations silica exposure can be reduced through process changes or modifications. For instance:

- Abrasive operations that produce a coarse dust are less hazardous than those that produce a fine dust. Coarse dusts settle more readily and are less likely to be trapped in the lungs if inhaled. The substitution of a mechanical process by a manual process, for example, will result in the production of a coarser dust.
- Wet methods should be used to reduce dust where practical. For example, if rock is slowly wetted before it is moved or worked on, dust can be suppressed at the source. Wet methods can also limit dust generation in operations such as cutting and grinding. Water fogs produced by fog guns at grinders and shakeout and during transfer operations can markedly reduce dust in foundries.
- Processes can be designed to include automatic shut-off valves or warning signals wherever possible. Alarms can be installed to warn of high pressure, low or high temperature, pump failure, low or high levels and failure of ventilation systems.

Enclosure/Isolation

Processes that generate silica dust should be in enclosed systems whenever possible. Enclosure or isolation of the source of dust can be done in a number of ways. Dusty operations can be grouped and carried out in areas separated from non-dusty workplaces or they can be completely walled off from the general plant atmosphere. They may be totally enclosed in a cabinet, as is done, for example, in finishing operations in foundries. In some operations the worker can be isolated in a ventilated cab. Conveyors that transport silica or silica-containing materials can be enclosed and vented to dust collectors or baghouses.

Ventilation

Proper ventilation is particularly important in situations where harmful concentrations of free crystalline silica may arise. Ventilation systems should be designed and maintained to prevent the accumulation and recirculation of harmful concentrations of free crystalline silica in the workplace. Regular maintenance and cleaning of air filters is essential to keeping the ventilation system operating effectively.

Local exhaust ventilation and complete enclosure of processes (where practical) should be used to confine and remove dust at the source. Exhausted air should be conveyed to an appropriate air cleaning device for collection of silica dust (e.g. high production crushing, grinding, drying, screening, abrasive blasting, drilling or foundry operations) require high quality system design, installation and operation, and it is imperative that continuous surveillance and preventive maintenance of production facilities be conducted.

Good general ventilation is effective for controlling hot fumes (i.e. from melting and pouring), but it is not normally effective for diluting silica dust. Local exhaust ventilation is preferable to general dilution ventilation, especially in mixers, forming machinery, grinders and conveyors. In foundries control of dust from portable grinders is achievable with down-draft benches and high velocity, low volume exhaust systems. However, it is often difficult to completely eliminate airborne silica through local exhaust ventilation alone.

Standard practices in the design of industrial exhaust systems can be found in appropriate reference texts.

Work Practices and Hygiene Practices

Rigorous adherence to good hygiene practices (as outlined in Chapter 4 of *A General Guide to the Regulations)* is essential to control inhalation of silica dust. Hygiene facilities with a "double locker system" should be used whenever there is significant exposure to silica dust. Silica can accumulate on the hands, clothing and hair. From there it can be disturbed, re-suspended in air and inhaled. Workers should be able to wash and shower at the end of each shift. Smoking, eating, drinking or chewing in contaminated areas must be strictly forbidden. Lunches must be stored in an uncontaminated area.

Dusty jobs can also be carried out at specific times such as the end of the shift or when most of the workers are away from the plant. Scrap receptacles for silica dust should be kept tightly covered to prevent dust from becoming airborne. Cleaning by blowing with compressed air or dry sweeping should be avoided; methods of cleaning such as vacuuming as described above or washing down with water should be used.

Housekeeping Measures

Good housekeeping is crucial wherever silica dust is generated. Silica dust must be cleaned from machinery, floors, ledges and other surfaces daily by wet sweeping or the use of sweeping compounds or special vacuum cleaners. Vacuum cleaners should be fitted with a high-efficiency particulate filter (HEPA) designed to trap silica and prevent the re-circulation of dusty air.

Keeping floors wet can help to control dust levels. Cleaning and wetting of floors should be done with a fine spray of water to avoid stirring up dust.

Protective Clothing

Where exposure to crystalline free silica occurs, protective work clothing should be vacuumed before removal. Clothes should not be cleaned by blowing or shaking. Safety glasses, goggles or face shield and full body protective clothing should be worn for dusty operations, e.g. abrasive sandblasting.

Respiratory Protection

The type of respirator that should be worn to protect against exposure to silica depends on the concentration of respirable free silica in the air and should be approved by NIOSH or an equivalent approval agency. The *Code for Respiratory Equipment for Silica,* which is referenced by the regulation, specifies the type of respirator required for different conditions of exposure. Use of respirators should conform to the practices outlined in Chapter 5 of *A General Guide to the Regulations.*

The Type of Respirator Required

The respiratory equipment provided by an employer and used by a worker must meet or exceed the requirements shown in Table 3:

TABLE 3

Respirator Requirements For Silica Exposure

Airborne Concentration	Type of Respirator Required
Respirable Silica, any crystalline form (calculated in terms of a factor above the time-weighted average exposure value (TWAEV))	
Less than or equal to 10 x TWAEV	Half-mask particulate respirator with N-, R-, or P-series filter and 95, 99 or 100% efficiency.
Less than or equal to 25 x TWAEV	Powered air purifying respirator equipped with a hood or helmet and any type of particulate filter, or supplied air respirator equipped with a hood or helmet and operated in a continuous flow mode (see note 1).

Notes:

1. Respirators with higher protection factors or required for protection from higher airborne silica concentrations must be selected in accordance with the NIOSH assigned protection factors as given in Table 1 of its publication entitled *NIOSH Respirator Decision Logic* dated May 1987; and respirators for escape must be selected in accordance with Table 4 of this NIOSH publication.

2. Respirators need not be worn if the levels of silica are less than the time-weighted average exposure limit (TWAEV). However, if a worker wishes to use a respirator at exposures less than the TWAEV, the correct type of respirator must be worn.

4. Measuring Airborne Silica

Chapter 6 of *A General Guide to the Regulations* provides advice on the principles of conducting air monitoring to determine worker exposure to designated substances. Air monitoring consists of two distinct processes: the collection of samples of workplace air and then analysis of the samples to determine the quantity of the designated substance they contain.

The principle of a personal sampling method for silica is to draw air at a specified flow rate for a known duration through a particle size-selective device. The device should simulate the deposition pattern of particles in the lung, i.e., the sample collected should represent the respirable fraction of the total airborne particulate. The regulation's definition for "respirable" indicates that the dust collection device must meet the American Conference of Governmental Industrial Hygienists (ACGIH) particle size-selective criteria and have a cut point of four microns at 50 per cent collective efficiency. Generally, sampling is carried out for a full work shift or for the duration of the operation during which the worker is exposed to silica.

The quantity of silica in a sample should be determined using an appropriate analytical technique for measuring crystalline silica. Knowledge of the mass of silica collected and the volume of air sampled permits the air concentration of crystalline silica to be determined. The time-weighted average (TWA) exposure of the worker can then be calculated according to the schedule appended to the regulation. Examples of how to calculate the TWA exposure of a worker are given in Chapter 6 of *A General Guide to the Regulations*.

Compliance with the regulation requires the use of procedures that are in accordance with standard methods for workplace air sampling and analysis, i.e., methods published by agencies such as NIOSH (the U.S. National Institute for Occupational Safety and Health), OSHA (U.S. Occupational Safety and Health Administration), HSE (U.K. Health and Safety Executive), ASTM (American Society for Testing and Materials) and ISO (International Organization for Standardization).

5. Medical Surveillance for Exposure to Silica

The silica regulation requires that the control program provide for a medical surveillance program, which must include:

- pre-employment, pre-placement and periodic medical examinations
- clinical tests
- health education
- record keeping.

The medical surveillance program is outlined in detail in the *Code for Medical Surveillance for Silica* and is designed to protect the health of workers through educating all staff to the health hazards associated with silica exposure.

Section 3 of the Code explains what the physician should look for at the pre-placement and periodic medical examinations. Medical records kept by the physician should include the information listed in section 7 of the Code.

Clinical Tests

Section 4 of the Code explains clinical tests that are used in assessing the worker's silica exposure and fitness for continued exposure to silica. These include X-rays and pulmonary function tests.

X-rays

A chest X-ray, postero-anterior, should be taken at least once every two years. A lateral X-ray may be done at the discretion of the examining physician. If the worker has been examined within the past year, the examining physician should obtain the worker's medical status, where possible, from the previous examination to avoid unnecessary X-rays. Especially at pre-placement examinations, radiographs should be checked for early signs of silicosis or other chest diseases by a physician with proficiency in the classification of chest X-rays for the pneumoconioses using the International Labour Office (ILO) Classification System, such as a certified NIOSH B Reader. The examining physician should determine the duration and frequency of follow-up X-rays and surveillance. These will depend on the intensity and duration of exposure to silica.

Pulmonary Function Tests

Pulmonary function tests should be done in conjunction with the chest X-ray in accordance with section 4(2) of the Code.

Action Levels

An assessment of fitness for work should be based on the clinical examination in conjunction with the clinical tests. Before a worker is removed from exposure, the Ministry of Labour and Workplace Safety and Insurance Board (WSIB) chest physicians must be consulted. The health and livelihood of the affected worker must be considered before a worker is removed from work.

The Examining Physician

The silica regulation does not stipulate who shall be the examining physician, thus allowing the worker to select the doctor of his or her choice. As a result, the examining physician may be the company doctor, a private consultant with whom the employer contracts services, a physician on the staff of a clinic or the

personal physician of the worker. Every examining physician must know the content of the *Code for Medical Surveillance for Exposure to Silica* and his or her responsibilities. Where there is more than one examining physician, a physician should be appointed in a co-ordinating role. The role of the co-ordinating physician, who should be selected jointly by the employer and the joint health and safety committee, should be to standardize examination and test procedures, maintain medical records and identify any trends in examination and test results.

Physicians Reporting Protocol

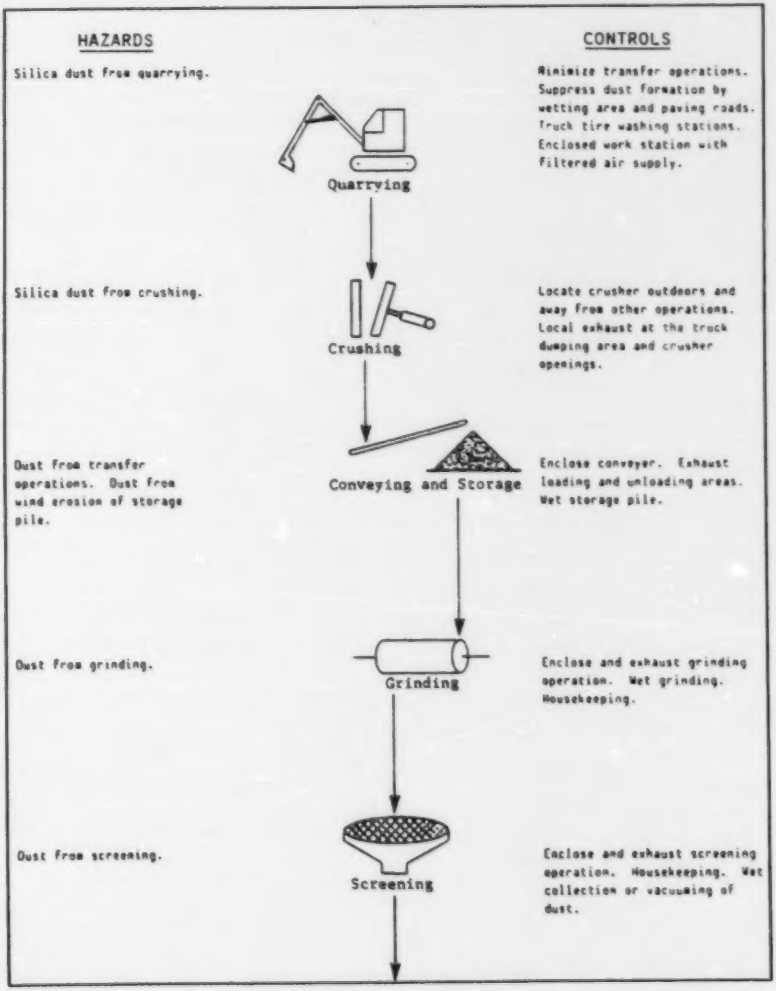
The regulation requires the examining physician to advise the employer whether the worker is fit, fit with limitations or unfit for exposure to silica. This determination is a professional judgment based on the results of medical examinations and clinical tests. **The physician must give this opinion without disclosing to the employer the results of the examinations or tests.**

The designated substance regulation for silica also requires the physician to advise the worker's joint health and safety committee in writing of the results of clinical tests, along with an opinion as to how these tests should be interpreted and an opinion as to the fitness of the worker for exposure. In all such cases the committee must receive this information on a confidential basis. If the physician has advised the employer that a worker is fit with limitations or unfit, he or she must also report this information to the Ministry of Labour's Provincial Physician. These requirements are specified in sections 16(1), 16(2) and 16(5) of the regulation.

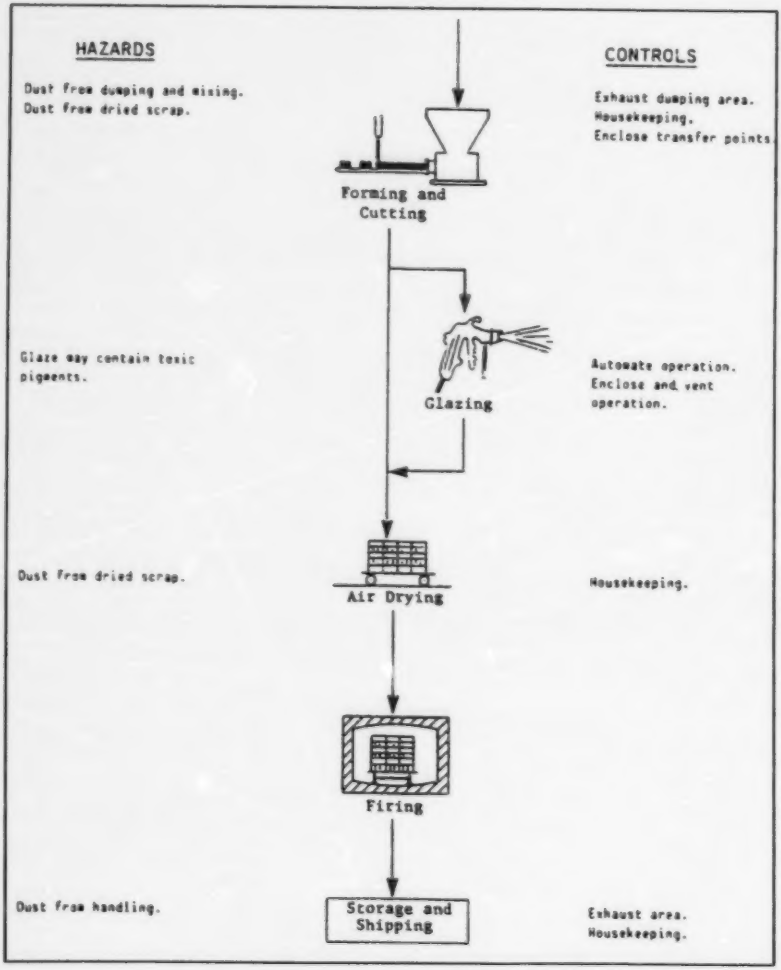
6. Appendices

Appendix 1 – Process Flow Sheets

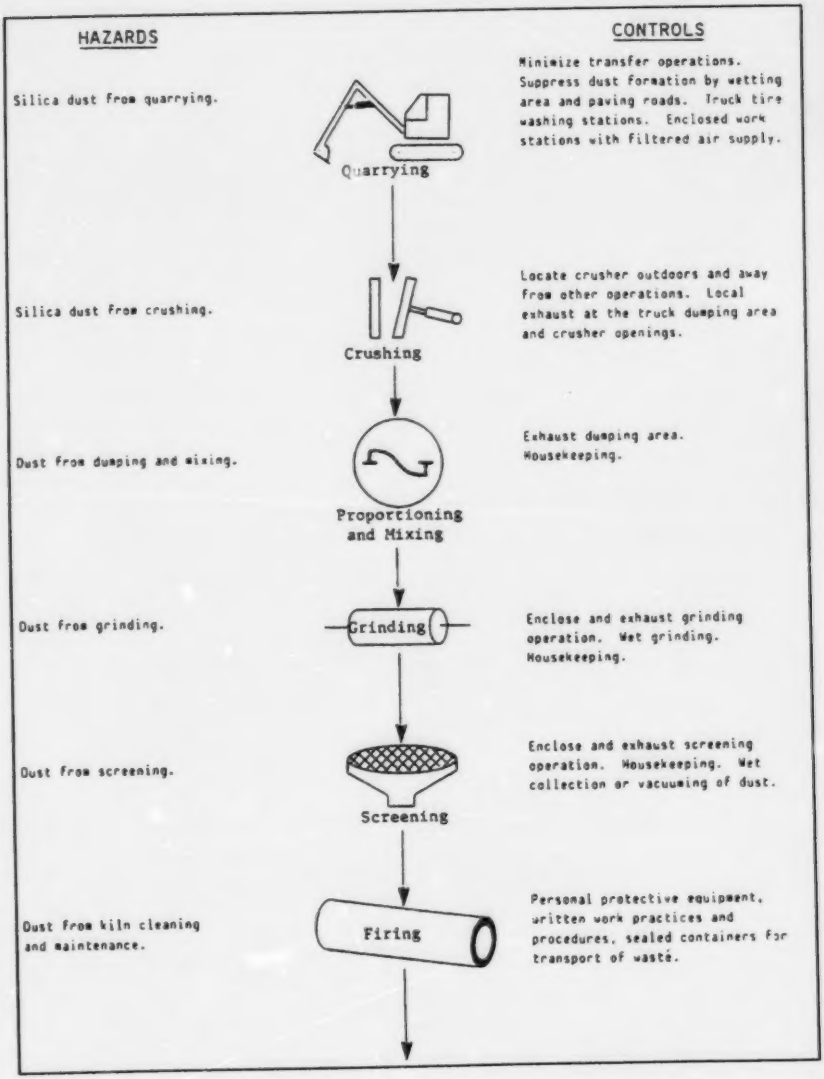
PROCESS FLOW SHEET FOR INSPECTORS
BRICK MANUFACTURING
SILICA


HAZARDS
CONTROLS
Silica dust from quarrying.
Minimize transfer operations. Suppress dust formation by wetting area and paving roads. Truck tire washing stations. Enclosed work station with filtered air supply.
Quarrying
Silica dust from crushing.
Locate crusher outdoors and away from other operations. Local exhaust at the truck dumping area and crusher openings.
Crushing
Dust from transfer operations. Dust from wind erosion of storage pile.
Enclose conveyer. Exhaust loading and unloading areas. Wet storage pile.
Conveying and Storage
Dust from grinding.
Enclose and exhaust grinding operation. Wet grinding. Housekeeping.
Grinding
Dust from screening.
Enclose and exhaust screening operation. Housekeeping. Wet collection or vacuuming of dust.
Screening

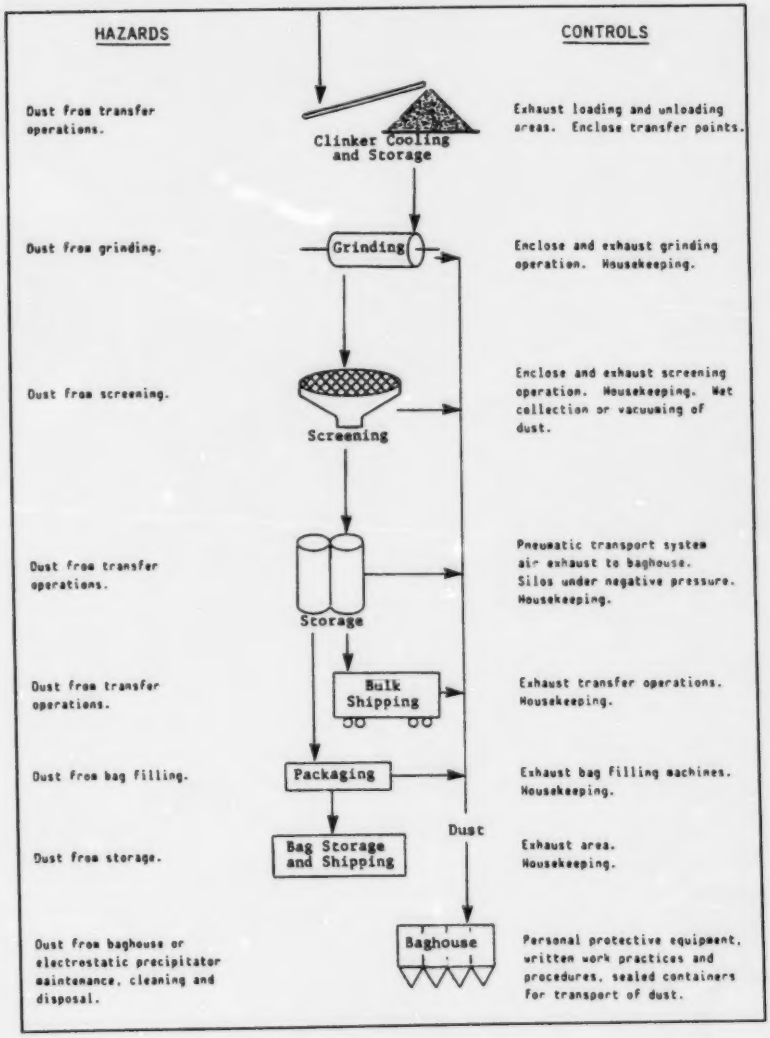
BRICK MANUFACTURING
SILICA
(continued)



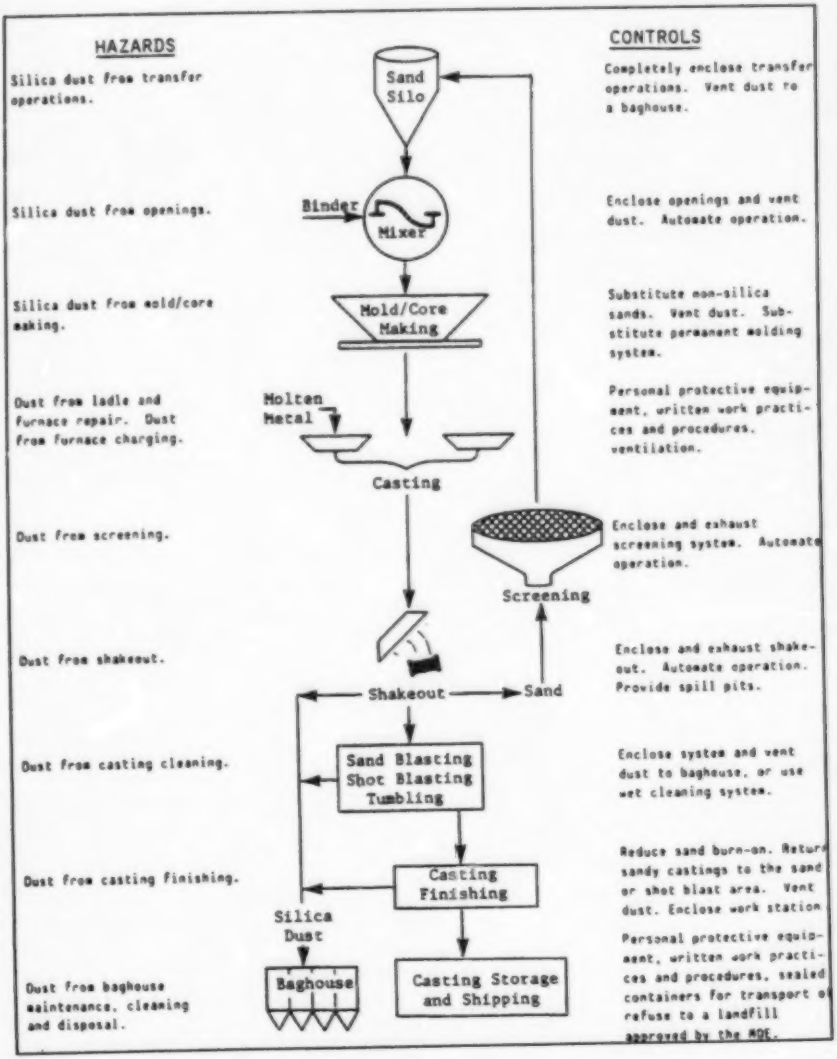
PROCESS FLOW SHEET FOR INSPECTORS
CEMENT MANUFACTURING
SILICA


HAZARDS
CONTROLS
Silica dust from quarrying.
Minimize transfer operations. Suppress dust formation by wetting area and paving roads. Truck tire washing stations. Enclosed work stations with filtered air supply.
Quarrying
Silica dust from crushing.
Locate crusher outdoors and away from other operations. Local exhaust at the truck dumping area and crusher openings.
Crushing
Dust from dumping and mixing.
Exhaust dumping area. Housekeeping.
Proportioning and Mixing
Dust from grinding.
Grinding
Enclose and exhaust grinding operation. Wet grinding. Housekeeping.
Dust from screening.
Enclose and exhaust screening operation. Housekeeping. Wet collection or vacuuming of dust.
Screening
Dust from kiln cleaning and maintenance.
Firing
Personal protective equipment, written work practices and procedures, sealed containers for transport of waste.

CEMENT MANUFACTURING
SILICA
(continued)


HAZARDS
CONTROLS
Dust from transfer operations.
Clinker Cooling and Storage
Exhaust loading and unloading areas. Enclose transfer points.
Dust from grinding.
Grinding
Enclose and exhaust grinding operation. Housekeeping.
Dust from screening.
Screening
Enclose and exhaust screening operation. Housekeeping. Wet collection or vacuuming of dust.
Dust from transfer operations.
Storage
Pneumatic transport system air exhaust to baghouse. Silos under negative pressure. Housekeeping.
Dust from transfer operations.
Bulk Shipping
Exhaust transfer operations. Housekeeping.
Dust from bag filling.
Packaging
Exhaust bag filling machines. Housekeeping.
Dust from storage.
Bag Storage and Shipping
Exhaust area. Housekeeping.
Dust
Dust from baghouse or electrostatic precipitator maintenance, cleaning and disposal.
Baghouse
Personal protective equipment, written work practices and procedures, sealed containers for transport of dust.

PROCESS FLOW SHEET FOR INSPECTORS
FOUNDRY SAND
SILICA


HAZARDS
CONTROLS
Silica dust from transfer operations.
Completely enclose transfer operations. Vent dust to a baghouse.
Sand Silo
Silica dust from openings.
Binder
Mixer
Enclose openings and vent dust. Automate operation.
Silica dust from mold/core making.
Mold/Core Making
Substitute non-silica sands. Vent dust. Substitute permanent molding system.
Dust from ladle and furnace repair. Dust from furnace charging.
Molten Metal
Personal protective equipment, written work practices and procedures, ventilation.
Casting
Dust from screening.
Screening
Enclose and exhaust screening system. Automate operation.
Dust from shakeout.
Shakeout
Sand
Enclose and exhaust shakeout. Automate operation. Provide spill pits.
Dust from casting cleaning.
Sand Blasting
Shot Blasting
Tumbling
Enclose system and vent dust to baghouse, or use wet cleaning system.
Dust from casting finishing.
Casting Finishing
Reduce sand burn-on. Return sandy castings to the sand or shot blast area. Vent dust. Enclose work station
Silica Dust
Dust from baghouse maintenance, cleaning and disposal.
Baghouse
Casting Storage and Shipping
Personal protective equipment, written work practices and procedures, sealed containers for transport of refuse to a landfill approved by the MDE.

Appendix 2 - Regulations made under the *Occupational Health and Safety Act* Revised Statutes of Ontario, 1990, Chapter O.1 as amended.

February 1, 2001

A. Safety Regulations

Construction Projects:	O. Reg. 213/91, as amended by O. Reg. 631/94, O. Reg. 143/99, O. Reg. 571/99, O. Reg. 145/00, and O. Reg. 527/00.
Industrial Establishments:	R.R.O. 1990, Reg. 851, as amended by O. Reg. 516/92, O. Reg. 630/94, O. Reg. 230/95, O. Reg. 450/97, O. Reg. 144/99, O. Reg. 284/99, and O. Reg. 528/00.
Mines and Mining Plants:	R.R.O. 1990, Reg. 854, as amended by O. Reg. 583/91, O. Reg. 584/91, O. Reg. 171/92, O. Reg. 384/92, O. Reg. 571/92, O. Reg. 693/92, O. Reg. 60/94, O. Reg. 779/94, O. Reg. 68/96, O. Reg. 272/97, O. Reg. 236/99 and O. Reg. 486/99.
Window Cleaning:	R.R.O. 1990, Reg. 859, as amended by O. Reg. 523/92.
Critical Injury Defined:	R.R.O. 1990, Reg. 834.
Training Requirements for Certain Skill Sets and Trades:	O. Reg. 572/99.
Diving Operations:	O. Reg. 629/94.
Firefighters—Protective Equipment:	O. Reg. 714/94, as amended by O. Reg. 449/97.
Health Care and Residential Facilities:	O. Reg. 67/93 as amended by O. Reg. 142/99.

Oil and Gas—Offshore:	R.R.O. 1990, Reg. 855.
Roll-Over Protective Structures:	R.R.O. 1990, Reg. 856.
Teachers:	R.R.O. 1990, Reg. 857.
University Academics and Teaching Assistants:	R.R.O. 1990, Reg. 858.

B. Designated Substances

Acrylonitrile:	R.R.O. 1990, Reg. 835, as amended by O. Reg. 507/92.
Arsenic:	R.R.O. 1990, Reg. 836, as amended by O. Reg. 508/92.
Asbestos:	R.R.O. 1990, Reg. 837, as amended by O. Reg. 509/92, O. Reg. 598/94 and O. Reg. 386/00.
Asbestos on Construction Projects and in Buildings and Repair Operations:	R.R.O. 1990, Reg. 838, as amended by O. Reg. 510/92.
Benzene:	R.R.O. 1990, Reg. 839, as amended by O. Reg. 511/92 and O. Reg. 387/00.
Coke Oven Emissions:	R.R.O. 1990, Reg. 840, as amended by O. Reg. 512/92.
Ethylene Oxide:	R.R.O. 1990, Reg. 841, as amended by O. Reg. 515/92.
Isocyanates:	R.R.O. 1990, Reg. 842, as amended by O. Reg. 518/92.
Lead:	R.R.O. 1990, Reg. 843, as amended by O. Reg. 519/92 and O. Reg. 389/00.
Mercury:	R.R.O. 1990, Reg. 844, as amended by O. Reg. 520/92 and O. Reg. 390/00.
Silica:	R.R.O. 1990, Reg. 845, as amended by O. Reg. 521/92 and O. Reg. 391/00.
Vinyl Chloride:	R.R.O. 1990, Reg. 846, as amended by O. Reg. 522/92 and O. Reg. 392/00.

C. General

Biological or Chemical Agents, Control of Exposure to:	R.R.O. 1990, Reg. 833, as amended by O. Reg. 513/92, O. Reg. 597/94 and O. Reg. 388/00.
Hazardous Materials Inventories:	R.R.O. 1990, Reg. 850, revoked by O. Reg. 397/93.
Workplace Hazardous Materials Information System:	R.R.O. 1990, Reg. 860, as amended by O. Reg. 36/93.

D. Hazardous Physical Agents

X-Ray Safety:	R.R.O. 1990, Reg. 861.

E. Regulations that Directly Affect/Impact the Act

Training Programs:	O. Reg. 780/94.
Unilateral Work Stoppage:	O. Reg. 243/95.
Inventory of Agents or Combinations of Agents for the Purpose of Section 34 of the Act:	R.R.O. 1990, Reg. 852, as amended by O. Reg. 517/92.
Joint Health & Safety Committees— Exemption from Requirements:	O. Reg. 385/96, as amended by O. Reg. 131/98.

NOTE:

For a complete reference to the Regulations made under the *Occupational Health and Safety Act*, please see the Annual Consolidated Index to the Regulations of Ontario.

Appendix 3 - Ministry of Labour Field Offices

CENTRAL REGION

Toronto North
1201 Wilson Ave
West Bldg, 2nd Fl
Downsview M3M 1J8
(416) 235-5330
Fax (416) 235-5080

Toronto West
1201 Wilson Ave
West Bldg, 2nd Fl
Downsview M3M 1J8
(416) 235-5330
Fax (416) 235-5090

Peel North
The Kaneff Centre, 1st Fl
1290 Central Pkwy West
Mississauga L5C 4R3
(905) 273-7800
*1-800-268-2966
Fax (905) 615-7098

Peel South
The Kaneff Centre, 1st Fl
1290 Central Pkwy West
Mississauga L5C 4R3
(905) 273-7800
*1-800-268-2966
Fax (905) 615-7098

Toronto East
2275 Midland Ave, Main Fl
Scarborough M1P 3E7
(416) 314-5300
Fax (416) 314-5410

Durham
209 Dundas St E, Ste 204
Whitby L1N 7H8
(905) 665-4979
*1-800-263-1195
Fax (905) 665-4983

Barrie
114 Worsley St, Ste 201
L4M 1M1
(705) 722-6642
*1-800-461-4383
Fax (705) 726-3101

York
1110 Stellar Drive, Unit 102
Newmarket L3Y 7B7
(905) 715-7020
*1-888-299-3138
Fax (905) 715-7140

EASTERN REGION

Ottawa West
1111 Prince of Wales Dr,
Ste 200
K2C 3T2
(613) 228-8050
*1-800-267-1916
Fax (613) 727-2900

Ottawa East
1111 Prince of Wales Dr,
Ste 200
K2C 3T2
(613) 228-8050
*1-800-267-1916
Fax (613) 727-2900

Kingston
Beechgrove Complex
51 Heakes Lane
K7M 9B1
(613) 545-0989
*1-800-267-0915
Fax (613) 545-9831

Peterborough
Robinson Place (MNR Bldg.)
300 Water St N
3rd Fl South Tower
K9J 8M5
(705) 755-4700
*1-800-461-1425
Fax (705) 755-4724

NORTHERN REGION

Sudbury West
159 Cedar St, Ste 301
P3E 6A5
(705) 564-7400
*1-800-461-6325
Fax (705) 564-7435

Sudbury East
159 Cedar St, Ste 301
P3E 6A5
(705) 564-7400
*1-800-461-6325
Fax (705) 564-7435

Sault Ste. Marie
70 Foster Dr, Ste 480
P6A 6V4
(705) 945-6600
*1-800-461-7268
Fax (705) 949-9796

Elliot Lake
50 Hillside Dr N
P5A 1X4
*1-800-461-7268
Fax (705) 848-8055

Thunder Bay
435 James St S, Ste 222
P7E 6S7
(807) 475-1691
*1-800-465-5016
Fax (807) 475-1646

Dryden
479 Government Rd
P8N 3B3
(807) 223-4898
*1-800-465-5016
Fax (807) 223-4344

Timmins
(mailing address)
P.O. Bag 3050
South Porcupine P0N 1H0

(office address)
Ontario Government Complex
D Wing
Highway 101 E
Porcupine P0N 1C0
(705) 235-1900
*1-800-461-9847
Fax (705) 235-1925

Kapuskasing
c/o MNR
RR #2, Hwy 17 W
P5N 2X8
(705) 235-1900
*1-800-461-9847
Fax (705) 335-8330

North Bay
447 McKeown Ave, 2nd Fl
P1B 9S9
*1-800-461-6325
Fax (705) 497-6850

WESTERN REGION

Hamilton
1 Jarvis St, Main Fl
L8R 3J2
(905) 577-6221
*1-800-263-6906
Fax (905) 577-1200

Brant
1 Jarvis St, Main Fl
Hamilton L8R 3J2
(905) 577-6221
*1-800-263-6906
Fax (905) 577-1324

Halton
1 Jarvis St, Main Fl
Hamilton L8R 3J2
(905) 577-6221
*1-800-263-6906
Fax (905) 577-1324

Niagara
301 St. Paul St, 8th Fl
St. Catharines L2R 7R4
(905) 704-3994
*1-800-263-7260
Fax (905) 704-3011

London North
217 York St, 5th Fl
N6A 5P9
(519) 439-2210
*1-800-265-1676
Fax (519) 672-0268

London South
217 York St, 5th Fl
N6A 5P9
(519) 439-2210
*1-800-265-1676
Fax (519) 672-0268

Kitchener
155 Frobisher Dr, Unit G213
Waterloo N2V 2E1
(519) 885-3378
*1-800-265-2468
Fax (519) 883-5694

Windsor
250 Windsor Ave, Ste 635
N9A 6V9
(519) 256-8277
*1-800-265-5140
Fax (519) 258-1321

MAIN OFFICE

Toronto
400 University Ave, 7th Fl
M7A 1T7

Occupational Health and Safety Branch - (416) 326-7770

Construction Health and Safety Program - (416) 326-2439

Industrial Health and Safety Program - (416) 326-2445

Professional and Specialized Services - (416) 326-2443

Fax (416) 326-7761

Mining Health and Safety Program
Willet Green Miller Centre
Building B
933 Ramsey Lake Rd
Sudbury P3E 6B5
(705) 670-5695
Fax (705) 670-5698

Material Testing Laboratory
Willet Green Miller Centre
Building C
933 Ramsey Lake Road
Sudbury P3E 6B5
(705) 670-5695
Fax (705) 670-5698

Radiation Protection Service
81A Resources Rd
Weston M9P 3T1
(416) 235-5922
Fax (416) 235-5926

Publications
400 University Ave, 7th Fl
Toronto M7A 1T7
(416) 326-7731
*1-800-268-8013 ext 6-7731
[province-wide]
Fax (416) 326-7745

* Toll-Free Number [Note: Many of these "1-800" numbers are accessible only within the area code of the relevant office.]

For inquiries please contact the Ministry of Labour office nearest to you. Consult the blue pages in your local telephone directory for additional information

Appendix 4 – Supplementary Reading Materials

1. A Guide for Joint Health and Safety Committees and Representatives in the Workplace, Ontario Ministry of Labour.

2. A Guide to the Occupational Health and Safety Act, Ontario Ministry of Labour.